In the Specification:

The paragraph beginning at page 1, line 1:

~~The present application is a continuation-in-part of, and claims priority in, U.S. Application Serial No. 08/883,780 filed June 27, 1997, which is a continuation-in-part of Serial No. 08/807,046 filed February 24, 1997 which is a continuation-in-part of Serial No. 08/672,639 filed June 28, 1996, all incorporated by reference.~~

The present application is a continuation of U.S. Application No. 10/336,617 filed January 2, 2003, which is a continuation of U.S. Application No. 09/703,946 filed October 31, 2000, which is a continuation of U.S. Application No. 09/105,403 filed June 26, 1998 (now U.S. Patent No. 6,196,371), which is a continuation-in-part of U.S. Application No. 08/883,780 filed June 27, 1997 (now U.S. Patent No. 5,988,348), which is a continuation-in-part of U.S. Application No. 08/807,046 filed February 24, 1997, now abandoned, which is a continuation of U.S. Application No. 08/672,639 filed June 28, 1996, now abandoned; all are incorporated herein in their entireties by reference.

Page 4, line 37:

Figs. 22-22A ~~is a~~ are perspective views of the system of Fig. 17, showing an example of coin locations;

Page 5, line 7:

Figs. 29A-29B ~~is a~~ are block diagrams of functional components of a sensor board, according to an embodiment of the present invention;

Page 5, line 9:

Figs. 31A-31I ~~is a~~ are schematic diagrams of a sensor board, according to an embodiment of the present invention;

Page 5, line 13:

Figs. 35A-35B ~~is a~~ are state diagrams for a coin discrimination process according to an embodiment of the present invention;

The paragraph beginning at page 6, line 26:

Devices that may be used in connection with the coin chutes and the trommel 52 are described in PCT/US97/03136 Feb 28, 1997 and its parent provisional application U.S.S.N. 60/012-,964, both of which are incorporated by reference. In one embodiment, depicted in Figs. 51 and 53, the trommel cage 5112 is configured to facilitate removal, e.g. for cleaning or maintenance purposes or the like. In the embodiment depicted in Figs 48 – 54, trommel removal can be accomplished with only one hand, particularly by pressing button 5212 (Figs 52 and 54)_which moves socket 5414 (Figure ~~14~~54) out of engagement with cradle pin 5414 (Fig 54) permitting the cradle 5416 which bears the trommel cage (as shown in Fig 53) to pivot downward 5312 (Fig 53) from the position 4812 shown in Fig. 48 to the position 4912 shown in Fig. 49. The cradle 5416 includes a telescoping section 5418a,b for permitting the trommel cage to be further retracted to the position 5012 shown in fig 50 where it can be easily lifted from the cradle.

The paragraph beginning at page 9, line 14:

Preferably, sharp or irregular surfaces which may stop or entrap coins are avoided. Thus, covers 1856~~a, b, c, d~~ are placed over the springs 1854a, b, c, d and conically-shaped washers 1858a, b, c, d protect the pivot pins 1848a, b, c, d. In a similar spirit, the edge of the tension disk 1862 is angled or chamfered to avoid coins hanging on a disk edge, potentially causing jamming.

The paragraph beginning at page 10, line 1:

As the paddle heads 2028 continue to move along the circular path, they contact the linear portion 1834 (Fig. 19) of the ledge 1804 and flex axially outward ~~2032~~, facilitated by a tapered shape of the radially inward portion of the paddle pad 2028 to ride over (i.e. in front of) a portion 1884 of the rail disk. In one embodiment,

openings or holes 1708 are provided in this portion to reduce frictional drag and to receive e.g. trapped debris, which is thus cleared from the annular coin path.

The paragraph bridging pages 10 and 11:

Another feature contributing to singulation is the change in inclination of the coin rail from a first portion 2121a which is inclined, with respect to a horizontal plane 2124 at an angle 2126 of about 0° to about 30°, preferably about 0° to about 15° and more preferably about 10°, to a second portion 2121b which is inclined with respect to a horizontal plane 2124 by an angle ~~2128~~ of about 30° to about 60°, preferably between about 40° and about 50° and more preferably about 45°. Preferably, the coin path in the transitional region 2121c between the first portion 2121a and second portion 2121b is smoothly curved, as shown. In one embodiment, the radius of curvature of the ledge 2104 in the transition region 2121c is about 1.5 inch (about 3.8 cm).

The paragraph beginning at page 12, line 7:

In the depicted configuration, the sensor 58 is configured so that it can be moved to a position 2142 away from the coin rail 56, for cleaning or maintenance, such as by sliding along slot 2144. Preferably, the device is constructed with an interference fit so that the sensor 58 may be moved out of position only when the diverter cover 1811 has been pivoted forward 1902 (Fig. 19) and such that the diverter cover 1811 may not be repositioned 1904 to its operating configuration until the sensor 2142 has been properly positioned in its operating location (Fig. 21). In another embodiment, depicted in Figs 43A - 47, closing the diverter cover 1811 before the sensor 2142 has been properly positioned, is prevented by interference with a pin 4312 (rather than interference with the sensor itself, which could result in impact and/or damage to the sensor). In the depicted embodiment, the pin 4312 is registered with a hole 4313 in the diverter cover 1811 when the sensor ~~2412~~ 2142 is in the unretracted position shown in Fig. 43A. Fig 44 shows the configuration with the diverter cover 1811 open. With the diverter cover 1811 in the open position, the sensor 2142 can be moved from the unretracted position (Figures 43A, 44) to the retracted position (Fig 46), eg. For

purposes of cleaning, maintenance and the like. Fig. 45 is a rear view showing the bottom edge 4511 of the sensor assembly protruding from under a sensor cover 4512. In the depicted embodiment, when the sensor is retracted the bottom edge 4511 moves from the position shown in fig 45 to the position shown in fig 47. (Although Fig 47 shows the cover 4512 moving with the sensor, it is also possible to configure the cover 4512 to be stationary while the sensor 2142 is retracted.) To avoid accidentally leaving the sensor in the retracted position when the cleaning and maintenance operations are completed, as the sensor is retracted, the bottom edge 4511 moves a pin 4515, projecting rearwardly from a rotatably-mounted disk 4517. Movement of the pin 4515 causes the disk 4517 to rotate 4519, against the urging of spring 4521, carrying the pin 4312 to the position shown in fig 46, out of registration with the hole 4313. When thus moved, the pin 4312 is positioned such that, if an attempt is made to close 4612 the diverter cover 1811 while the sensor is retracted (Fig. 46) the rear surface of the diverter cover 1811 will strike the pin 4312, preventing closure of the cover 1811. By sliding the sensor to its unretracted position (Fig. 44) the spring 4521 rotates the disk 4517 to return the pin 4312 to the position depicted in Fig. 44, registered with the hole 4313, permitting closure of the cover 1811. Preferably, the sensor apparatus is configured so that it will seat reliably and accurately in a desired position with respect to the coin rail such as by engagement of a retention clip 2704 (Fig. 21). Such seating, preferably combined with a relatively high tolerance for positional variations of coins with respect to the sensor (described below), means that the sensor may be moved to the maintenance position 2142 and returned to the operating position repeatedly, without requiring recalibration of the device.

The paragraph beginning at page 12, line 29:

In the embodiment depicted in Fig. 43, a coin return ramp 4312 extends from the coin return region ~~1921~~1912, through the opening 1813 of the diverter cover 1811 and extends a distance 4314 outward and above the initial portion of the coin return chute 68. Thus, coins which are not deflected by the door 62 travel down the ramp 4312 and fly off the end 4316 of the ramp in a "ski jump" fashion before landing

on the coin return chute surface 68. Even though preferably, coin contact surfaces such as the ramp 4312 and coin return chute 68 are embossed or otherwise reduce facial contact with coins, providing the "ski jump" flying region further reduces potential for slowing or adhesion of coins (or other objects) as they travel down the return chute towards the customer return box.

The paragraph beginning at page 17, line 4:

Figs. 29A-29B depict~~s~~ the major functional components of the sensor PCB 2512. In general, the sensor or transducer 58 provides a portion of a phase locked loop which is maintained at a substantially constant frequency. Thus, the low frequency coil leads are provided to a low frequency PLL 2902a and the high frequency leads are provided to high frequency sensor PLL 2902b.

The paragraph bridging pages 18 and 19:

Returning to the configuration of Figs. 29A-29B, as a coin passes through the transducer 58, the amplitude of the PLL error voltage 2909 a,b (sometimes referred to herein as a "D" signal) and the amplitude of the PLL sinusoidal oscillator signal (sometimes referred to as a "Q" signal) decrease. The PLL error voltage is filtered and conditioned for conversion to digital data. The oscillator signal is filtered, demodulated, then conditioned for conversion to digital data. Since these signals are generated by two PLL circuits (high and low frequency), four signals result as the "signature" for identifying coins. Two of the signals (LF-D, LF-Q) are indicative of low-frequency, coin characteristics, and the remaining two signals (HF-D, HF-Q) are indicative of high-frequency coin characteristics. Figure 30 shows a four channel oscilloscope plot of the change in the four signals (LF-D 3002, LF-Q 3004, HF-D 3006, and HF-Q 3008) as a coin passes the sensor. Information about the coin is represented in the shape, timing and amplitude of the signal changes in the four signals. The Control PCBA, which receives a digitized data representation of these signals, performs a discrimination algorithm to categorize a coin and determine its speed through the transducer, as described below.

The paragraph beginning at page 19, line 28:

The phase/frequency detector 31l4a, b performs certain control functions in this circuit. It compares the output frequency of the comparator ~~3l06a~~3104a, b to a synchronized reference clock signal and has an output that varies as the two signals diverge. The output stage of the device amplifies and filters this phase comparator output signal. This amplified and filtered output provides the VCO control signal used to indicate change of inductance in this circuit.

The paragraph beginning at page 26, line 21:

Fig. 2B depicts a sensor 212', positioned with respect to a coin conveying rail 232, such that, as the coin 224 moves down the rail ~~234~~232, the rail guides the coin ~~214~~ 224 through the gap 216 of the sensor 212'. Although Fig. 2B depicts the coin ~~214~~ 224 traveling in a vertical (on-edge) orientation, the device could be configured so that the coin 224 travels in other orientations, such as in a lateral (horizontal) configuration or angles therebetween. One of the advantages of the present invention is the ability to increase speed of coin movement (and thus throughput) since coin discrimination can be performed rapidly. This feature is particularly important in the present invention since coins which move very rapidly down a coin rail have a tendency to "fly" or move partially and/or momentarily away from the rail. The present invention can be configured such that the sensor is relatively insensitive to such departures from the expected or nominal coin position. Thus, the present invention contributes to the ability to achieve rapid coin movement not only by providing rapid coin discrimination but insensitivity to coin "flying." Although Fig. 2B depicts a configuration in which the coin 224 moves down the rail 232 in response to gravity, coin movement can be achieved by other unpowered or powered means such as a conveyor belt. Although passage of the coin through the gap 216 is depicted, in another embodiment the coin passes across, but not through the gap (e.g. as depicted with regard to the embodiment of Fig. 4).

The paragraph beginning at page 28, line 22:

In some situations, it may be necessary to provide a first driving signal frequency component in order to achieve a second, different frequency sensor signal component. In particular, it is found that if the sensor 212 (Fig. 2) is first driven at the high frequency using high frequency coil 242 and then the low frequency signal ~~220~~ is added, adding the low frequency signal will affect the frequency of the high frequency signal ~~242~~. Thus, the high frequency driving signal may need to be adjusted to drive at a nominal frequency which is different from the desired high frequency of the sensor such that when the low frequency is added, the high frequency is perturbed into the desired value by the addition of the low frequency.

The paragraph beginning at page 28, line 27:

Multiple frequencies can be provided in a number of ways. In one embodiment, a single continuous wave form 702 (Fig. 7), which is the sum of two (or more) sinusoidal or periodic waveforms having different frequencies 704, 706, is provided to the sensor. As depicted in Fig. 2C, a sensor 214 is preferably configured with two different coils to be driven at two different frequencies. It is believed that, generally, the presence of a second coil can undesirably affect the inductance of the first coil, at the frequency of operation of the first coil. Generally, the number of turns of the first coil may be correspondingly adjusted so that the first coil has the desired inductance. In the embodiment of Fig. 2C, the sensor core 214 is wound in a lower portion with a first coil 220 for driving with a low frequency signal 706 and is wound in a second region by a second coil 242 for driving at a higher frequency 704. In the depicted embodiment, the high frequency coil ~~742~~ 242 has a smaller number of turns and uses a larger gauge wire than the first coil 220. In the depicted embodiment, the high frequency coil 242 is spaced 242a, 242b from the first coil 220 and is positioned closer to the gap 216. Providing some separation 242a, 242b is believed to help reduce the effect one coil has on the inductance of the other and may somewhat reduce direct coupling between the low frequency and high frequency signals.

The paragraph beginning at page 29, line 1:

As can be seen from Fig. 7, the phase relationship of the high frequency signal 704 and low frequency signal 706 will affect the particular shape of the composite wave form 702. Signals 702 and 704 represent voltage at the terminals of the ~~high~~ low and ~~low~~ high frequency coils, 220, 242. If the phase relationship is not controlled, or at least known, output signals indicating, for example, amplitude and/or Q in the oscillator circuit as the coin passes the sensor may be such that it is difficult to determine how much of the change in amplitude or Q of the signal results from the passage of the coin and how much is attributable to the phase relationship of the two signals 704 and 706 in the particular cycle being analyzed. Accordingly, in one embodiment, the phases of the ~~low~~ high and ~~high~~ low signals 704, 706 are controlled such that sampling points along the composite signal 702 (described below) are taken at the same phase for both the ~~low~~ high and ~~high~~ low signals 704, 706. A number of ways of assuring the desired phase relationship can be used including generating both signals 704, 706 from a common reference source (such as a crystal oscillator) and/or using a phase locked loop (PLL) to control the phase relationship of the signals 704, 706. By using a phase locked loop, the wave shape of the composite signal 702 will be the same during any cycle (i.e., during any low frequency cycle), or at least will change only very slowly and thus it is possible to determine the sampling points (described below) based on, e.g., a pre-defined position or phase within the (low frequency) cycle rather than based on detecting characteristics of the wave form 702.

The paragraph beginning at page 31, line 3:

In one embodiment, the output signals ~~88a~~882a, 882b, 882a', 882b' are provided to a computer for coin discrimination or other analysis. Before describing examples of such analysis, it is believed useful to describe the typical profiles of the output signals 882a, 882b, 882a', 882b'. Fig. 9 is a graph depicting the output signals, e.g., as they might appear if the output signals were displayed on a properly configured oscilloscope. In the illustration of Fig. 9, the values of the high and low frequency Q signals 882a, 882a' and the high and low frequency D signals 882b, 882b' have values (depicted on the left of the graph of Fig. 9) prior to passage of a coin past the sensor,

which change as indicated in Fig. 9 as the coin moves toward the sensor, and is adjacent or centered within the gap of the sensor at time T_1, returning to substantially the original values as the coin moves away from the sensor at time T2.

The paragraph beginning at page 33, line 16:

Although the sensors have been described in connection with the coin counting or handling device, sensors can also be used in connection with coin activated devices, such as vending machines, telephones, gaming devices, and the like. In addition to using information about discriminated coins for outputting a printed voucher, the information can be used in connection with making electronic funds transfers, e.g. to the bank account of the user (e.g. in accordance with information read from a bank card, credit card or the like) and/or to an account of a third party, such as the retail location where the apparatus is placed, to a utility company, to a government agency, such as the U.S. Postal Service, or to a charitable, non-profit or political organization (e.g. as described in U.S. application Serial Number 08/852,328, filed May 7, 1997 for Donation Transaction method and apparatus, incorporated herein by reference. In addition to discriminating among coins, devices can be used for discriminating and/or quality control on other devices such as for small, discrete metallic parts such as ball bearings, bolts and the like. Although the depicted embodiments show a single sensor, it is possible to provide adjacent or spaced multiple sensors (e.g., to detect one or more properties or parameters at different skin depths). The sensors of the present invention can be combined with other sensors, known in the art such as optical sensors, mass sensors, and the like. In the depicted embodiment, the ~~coin~~ coil 242 is positioned on both a first side 244a of the gap and a second side 244b of the gap. It is believed that as the coin 224 moves down the rail 232, it will be typically positioned very close to the second portion 244b of the coil 242. If it is found that this close positioning results in an undesirably high sensitivity of the sensor inductance to the coin position (e.g. an undesirably large variation in inductance when coins "fly" or are otherwise somewhat spaced from the back wall of the rail 232), it may be desirable to place the high frequency coil 242 only on the second portion 244a (Fig. 2C) which is believed to be

normally somewhat farther spaced from the coin ~~242~~ 224 and thus less sensitive to coin positional variations. The gap may be formed between opposed faces of a torroid section, or formed between the opposed and spaced edges of two plates, coupled (such as by adhesion) to faces of a section of a torroid. In either configuration, a single continuous non-linear core has first and second ends, with a gap therebetween.

The paragraph beginning at page 37, line 13:

As noted, rather than using single-point comparisons, it is possible to use multiple data points (or a continuous curve) generated as the coin moves past or through the gap 216, 316. Profiles of data of this type can be used in several different ways. In the example of Fig. 14, a plurality of known denominations of coins are sent through the discriminating device in order to accumulate standard data profiles for each of the denominations 1402a, b, c, d, 1404a, b, c, d. These represent the average change in output from the in-phase amplitude detector 1104 and a 90-degree delay detector for (shown on the vertical axes) 1403 and acceptance ranges or tolerances 1405 as the coins move past the detector over a period of time, (shown on the horizontal axis). In order to discriminate an unknown coin or other object, the object is passed through or across the detector, and each of the in-phase amplitude detector 1104 and 90-degree delayed amplitude detector 1106, respectively, produce a curve or profile 1406, 1410, respectively. In the embodiment depicted in Fig. 8, the in-phase profile 1406 generated as a coin passes the detector 212, is compared to the various standard profiles for different coins 1402a, 1402b, 1402c, 1402d. Comparison can be made in a number of ways. In one embodiment, the data is scaled so that a horizontal axis between initial and final threshold values l406a equals a standard time, for better matching with the standard values l402a through 1402d. The profile shown in 1406 is then compared with standard profiles stored in memory l402a through 1402d, to determine whether the detected profile is within the acceptable envelopes defined in any of the curves l402a through 1402d. Another method is to calculate a closeness of fit parameter using well known curve-fitting techniques, and select a denomination or several denominations, which most closely fit the sensed profile 1406. Still another

method is to select a plurality of points at predetermined (sealed) intervals along the time axis l406a (1408a, b, c, d) and compare these values with corresponding time points for each of the denominations. In this case, only the standard values and tolerances or envelopes at such predetermined times needs to be stored in the computer memory. Using any or all these methods, the comparison of the sensed data 1406, with the stored standard data l402a through l402d indicates, in this example, that the in-phase sensed data is most in accord with standard data for quarters or dimes 1409. A similar comparison of the 90-degree delayed data 1410 to stored standard 90-degree delayed data (1404a through 1404d), indicates that the sensed coin was either a penny or a dime. As before, using both these results, it is possible to determine that the coin was a dime ~~1404~~1414.